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A new species of *Simulium* (*Nevermannia*) (Diptera: Simuliidae) from Ibaraki, Japan

Hiroyuki TAKAOKA[1] and Katsumi SAITO[2]

[1] *Department of Infectious Disease Control, Faculty of Medicine, Oita University, Hasama, Yufu City, Oita, 879-5593 Japan*
[2] *Laboratory of Medical Zoology, College of Environmental Health, Azabu University, Fuchinobe 1-17-71, Sagamihara City, Kanagawa, 229-8501 Japan, and Department of Medical Entomology, National Institute of Infectious Diseases, Toyama 1-23-1, Shinjuku District, Tokyo, 162-8640 Japan*

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Abstract: *Simulium* (*Nevermannia*) *ibarakiense* sp. nov. is described on the basis of the reared adult females, males, pupae and mature larvae collected from Ibaraki Prefecture, Honshu, Japan. This new species belongs to the *vernum* species-group and is very similar to *S.* (*N.*) *uemotoi* Sato, Takaoka and Fukuda in all stages but is distinguished from the latter species by the dark legs of the adults, the greater number of the male large eye-facets, the absence of a pair of small yellowish-brown spots on the larval abdominal segments 3–5 (or 6), and the presence of accessory sclerites in some larvae.

Key words: *Nevermannia*, Simuliidae, *Simulium*, black fly, *vernum* species-group, Japan

Sato et al. (2004) described *Simulium* (*Nevermannia*) *uemotoi* from Japan, which is among the few species in the *vernum* species-group having the katepisternum with a few hairs on each side. Recently, we collected another species which is very similar to *S.* (*N.*) *uemotoi* but differs in several features including the color of the legs of both female and male adults and the number of the large eye facets of the male.

Here it is described as a new species on the basis of the female, male, pupal and larval specimens collected in Ibaraki Prefecture, Japan.

The terms for morphological features used here follow those of Takaoka (2003). Holotype and paratype specimens of the new species are deposited at the Department of Infectious Disease Control, Faculty of Medicine, Oita University, Oita, Japan.

Simulium (*Nevermannia*) *ibarakiense* sp. nov.

DESCRIPTION. **Female**. Body length 2.9–3.5 mm. ***Head***. Slightly narrower than width of thorax. Frons dark brown, thinly whitish-gray pruinose, not shiny, moderately covered with yellow recumbent short hairs interspersed with a few dark brown long hairs along lateral margins except median portion narrowly bare longitudinally (no dark hairs in some females); frontal ratio 1.54–1.85 : 1.00 : 1.77–2.85. Frons-head ratio 1.0 : 4.7–5.9. Fronto-ocular area (Fig. 1A) directed laterally and somewhat upwardly, deep, rounded apically. Clypeus dark brown, thinly whitish-gray pruinose, slightly shiny at certain angle of light, moderately covered with yellow short and long hairs interspersed with several dark brown long hairs on lower 1/2 (no dark hairs in some females). Labrum 0.59–0.69 times as long as clypeus. Antenna composed of scape, pedicel, and 9 flagellomeres, dark brown except scape, pedicel, and base of 1st flagellomere

ochreous; 1st flagellomere about 1.8 times as long as 2nd one. Maxillary palp composed of 5 segments, light to medium brown except segments 1 and 2 ochreous, proportional lengths of 3rd, 4th, and 5th segments 1.0 : 0.9 : 1.9–2.2; sensory vesicle (Fig. 1B) enlarged, ellipsoidal, 0.56–0.67 times as long as 3rd segment, and with medium-sized opening medially. Maxillary lacinia with 10–16 inner and 13–15 outer teeth. Mandible with 29 inner and 12 outer teeth. Cibarium (Fig. 1C) smooth. ***Thorax***. Scutum brownish-black except anterolateral calli medium brown, slightly shiny at certain angle of light, densely covered with yellow recumbent short hairs interspersed with yellow long upright hairs (with yellow long upright hairs mixed with dark ones in some females) on prescutellar area. Scutellum dark brown, slightly shiny at certain angle of light, covered with yellow short hairs and yellow long hairs (with yellow long hairs mixed with dark ones in some females). Postnotum dark brown, slightly shiny at certain angle of light, bare. Pleural membrane bare. Katepisternum dark brown, longer than deep, shiny, with 2–6 fine hairs on each lateral side. ***Legs***. Fore leg (Fig. 1D): coxa dark yellow to ochreous; trochanter light to medium brown; femur light to medium brown except apical cap dark brown; tibia yellow to ochreous medially with basal 1/5–1/3 light brown and apical 1/4–1/3 dark brown; tibia densely covered with yellow hairs on outer surface of basal 3/4; tarsus brownish-black; basitarsus somewhat dilated, 6.9 times as long as its greatest width. Midleg (Fig. 1E): coxa medium brown except posterior surface dark brown; trochanter dark yellow on basal 1/2 or more though narrowly darkened along lateral margins and apical tip, and widely light to medium brown except base pale on posterior surface (Fig. 1F); femur light brown except base dark yellow to ochreous and apical cap dark brown; tibia yellow to ochreous except base slightly darkened and apical 2/5 brownish-black; tibia densely covered with yellow hairs on basal 3/4; tarsus brownish-black. Hind leg (Fig. 1 G): coxa medium brown; trochanter light brown except inner surface pale; femur light to medium brown except base dark yellow and apical cap dark brown; tibia yellow to dark yellow on basal 1/2 with light brown spot subbasally, and dark brown on rest with apical cap brownish-black; tibia densely covered with yellow hairs on basal 3/5; basitarsus medium brown; rest of tarsus dark brown except basal 1/2 of 2nd segment light brown; basitarsus (Fig. 1H) slender, nearly parallel-sided though basal 1/6 and apical 2/3 tapered toward tips, 6.00–6.24 times as long as wide, and 0.75–0.76 and 0.62–0.65 times as wide as tibia and femur, respectively; calcipala well developed, 0.9 times as long as basal width; pedisulcus well developed at basal 1/3 of 2nd tarsal segment. Claws (Fig. 1I) each with large basal tooth 0.54 times as long as claw. All coxae, trochanters, femora moderately or densely covered with yellow short hairs at least on outer and posterior surfaces. ***Wing***. Length 2.6–3.1 mm. Costa with dark spinules and hairs except basal portion with patch of yellow hairs. Subcosta with dark hairs except apical 1/5 to 1/4 bare. Hair tuft on stem vein dark brown. Basal portion of radial vein fully haired. R_1 with dark spinules and hairs. R_2 with dark hairs only. Basal cell and basal median cell absent. ***Abdomen***. Basal scale light brown, with fringe of yellow long hairs; dorsal surface of segment 2 ochreous except medial 1/3 of tergite 2 medium brown, those of segments 3 and 4 medium brown except narrow area along posterior margin of each segment ochreous, and those of other segments dark brown; dorsal and dorsolateral surfaces of all segments moderately covered with yellow short hairs interspersed with dark short to medium-long hairs; at certain angle of light, tergite 2 slightly shiny dorsolaterally, and tergites 7–9 slightly shiny though tergite 6 also slightly shiny in some females; ventral surface of segments 2–4 ochreous, other segments light to medium brown; segment 7 with large sternal plate medially. ***Genitalia***. Sternite 8 (Fig. 1J) bare medially, and with 20–24 yellow short to long hairs and a few dark long hairs on each side. Ovipositor valves (Fig. 1J) roughly triangular, rounded medioposteriorly, thin, membranous, densely covered with microsetae interspersed with 6–8 yellow short fine setae; inner margin moderately sclerotized and narrowly darkened. Genital fork (Fig. 1K) of usual inverted-Y form, stem slender and well sclerotized; arms of moderate width, strongly folded apically, with wide weakly-sclerotized projection directed medioposteriorly though apex not sclerotized, then appearing irregularly broken. Paraproct in ventral view (Fig. 1L) rounded, narrowly bare and darkened along anterior margin, and with several sensilla on

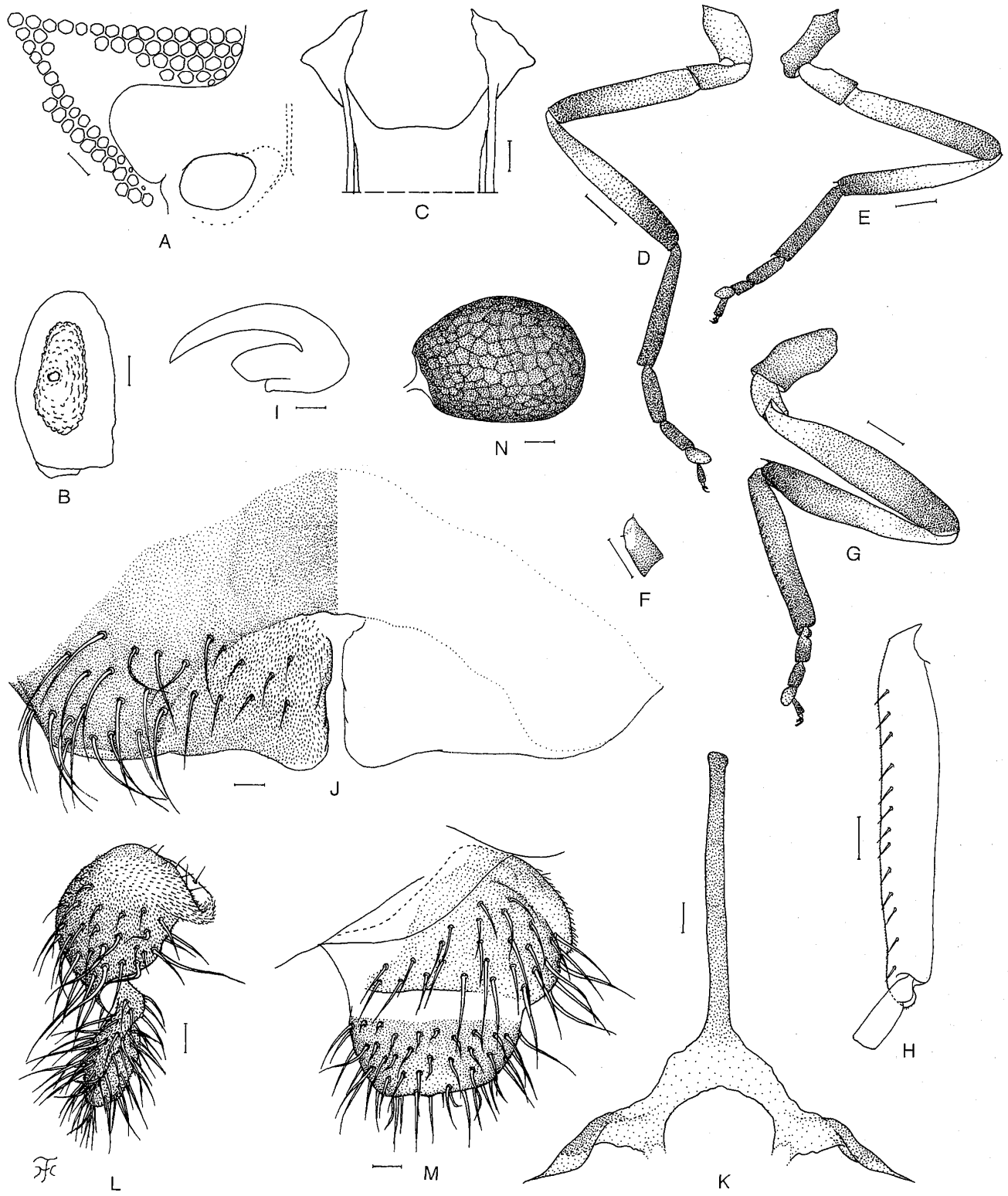
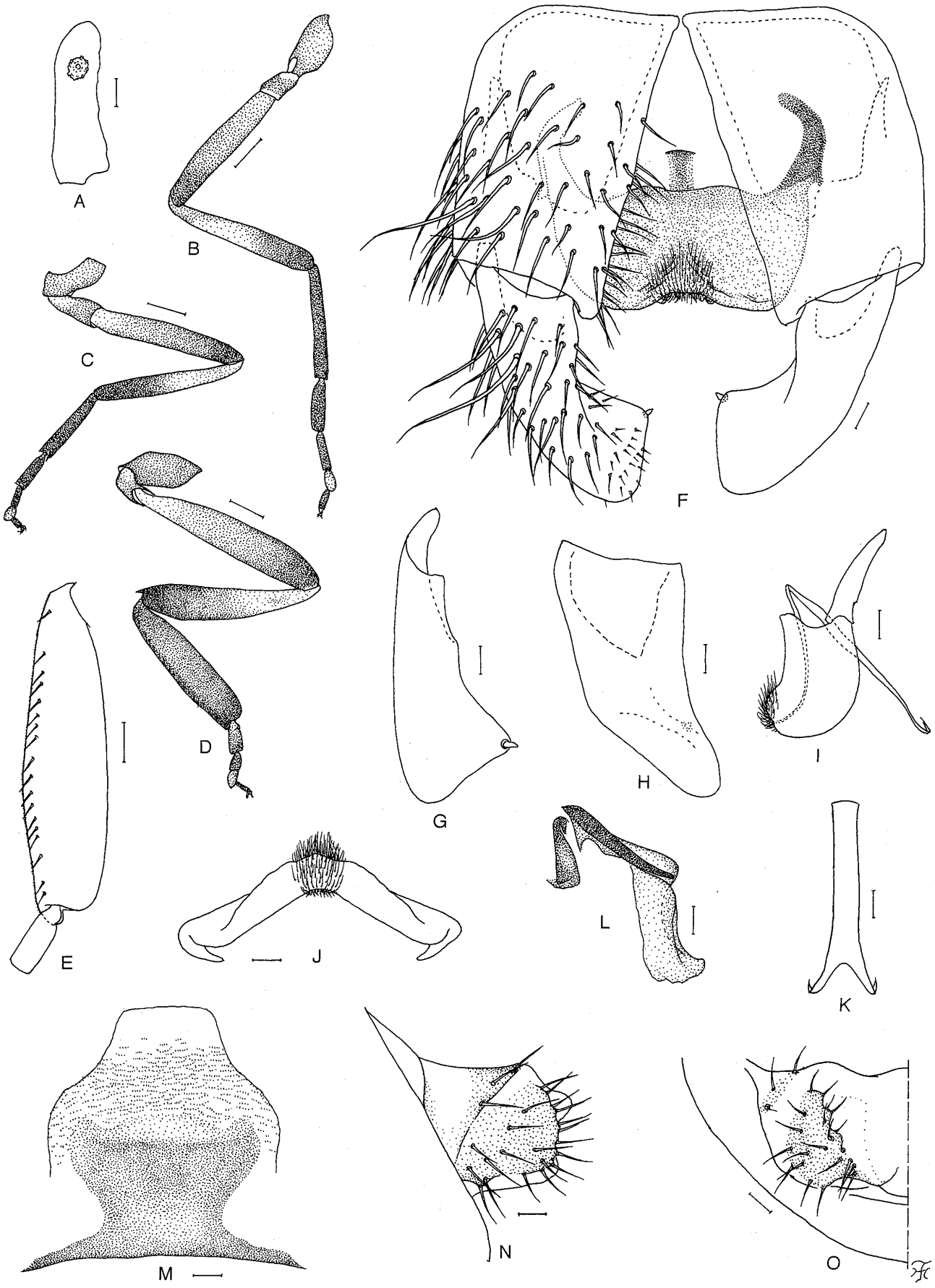


Fig. 1. Female of *Simulium* (*Nevermannia*) *ibarakiense* sp. nov. A, fronto-ocular area; B, 3rd maxillary palpal segment (right side, front view); C, cibarium; D, foreleg (left side, anterior view); E, midleg (left side, outer view); F, trochanter of midleg (left side, inner view); G, hind leg (left side, outer view); H, basitarsus and 2nd tarsal segment of hind leg (left side, outer view); I, claw; J, 8th sternite and ovipositor valves *in situ* (ventral view); K, genital fork (ventral view); L and M, paraprocts and cerci (right side; L, ventral view; M, lateral view); N, spermatheca (lateral view). Scale bars. 0.2 mm for D–G; 0.1 mm for H; 0.03 mm for A and B; 0.02 mm for C and J–N; 0.01 mm for I.

anteromedial surface; paraproct in lateral view (Fig. 1 M) slightly produced ventrally beyond ventral margin of cercus, with ventral margin notched medially. Cercus in ventral view (Fig. 1L) gently curved; cercus in lateral view (Fig. 1M) rounded or subrectangular, much wider than its length, and with numerous dark medium-long to long hairs. Spermatheca (Fig. 1N) small, ellipsoidal, 1.25 times as long as its greatest width, well sclerotized except small area at juncture with duct, with reticulate surface pattern; internal setae absent; both accessory ducts subequal in diameter to each other, and slightly larger in diameter than main duct.

Male. Body length 3.5–3.6 mm. ***Head***. Slightly narrower than width of thorax. Upper eye consisting of 18–20 vertical columns and 20 or 21 horizontal rows of large facets. Face brownish-black, thickly white pruinose. Clypeus brownish-black, whitish-gray pruinose, moderately covered with yellow long hairs intermixed with several dark long hairs. Antenna composed of scape, pedicel and 9 flagellomeres, dark brown except base of 1st flagellomere narrowly yellowish-white; 1st flagellomere somewhat elongate, 2.0 times as long as 2nd one. Maxillary palp composed of 5 segments, light to medium brown except segments 1 and 2 dark yellow, proportional lengths of 3rd, 4th, and 5th segments 1.00 : 1.04 : 2.34; sensory vesicle (Fig. 2A) small, globular or ellipsoidal, 0.16 times as long as 3rd segment, with very small opening. ***Thorax***. Scutum black, gray-pruinose and shiny widely along lateral margins and on prescutellar area at certain angle of light, densely covered with yellow short hairs interspersed with yellow long upright hairs (with yellow long upright hairs as well as a few dark ones in some males) on prescutellar area. Scutellum brownish-black, with yellow short and long hairs (interspersed with dark long hairs in some males). Postnotum brownish-black, bare. Pleural membrane and katepisternum as in female. ***Legs***. Foreleg (Fig. 2B): coxa light to medium brown; trochanter medium brown except basal and apical tips narrowly pale; femur medium brown except apical cap dark brown; tibia light to dark brown, with median portion of outer surface widely ochreous; tibia densely covered with yellow recumbent hairs on outer surface of basal 2/3; tarsus brownish-black; basitarsus cylindrical, 8.7–9.2 times as long as its greatest width. Midleg (Fig. 2C): coxa medium brown except posterior surface dark brown; trochanter medium to dark brown except basal 2/5 and anterior surface ochreous; femur medium brown except base ochreous and apical cap dark brown; tibia ochreous on basal 1/2 or a little more, dark brown to brownish-black on rest; tibia densely covered with yellow recumbent hairs on basal 2/3; tarsus brownish-black. Hind leg (Fig. 2D): coxa medium to dark brown; trochanter ochreous except middle of outer surface light brown; femur medium brown except base ochreous and apical cap dark brown; tibia ochreous on basal 2/5 with light brown spot subbasally, and medium to dark brown on the rest with apical cap brownish-black; tibia densely covered with yellow hairs on little more than basal 1/2; tarsus medium to dark brown; basitarsus (Fig. 2E) enlarged, spindle-shaped, 3.86–4.03 times as long as its greatest width, and 0.97–1.07 and 1.07–1.13 times as wide as greatest width of hind tibia and femur, respectively; calcipala well developed, nearly as long as or a little longer than its basal width; pedisulcus well developed at basal 1/4 of 2nd tarsal segment. All coxae, trochanters, femora moderately or densely covered with yellow short hairs at least on outer and posterior surfaces. ***Wing***. As in female except length 2.5–2.8 mm, and subcosta bare or with 1–3 dark hairs in some males. ***Abdomen***. Basal scale medium to dark brown, with fringe of yellow long hairs. Dorsal surface of abdominal segments medium to dark brown, moderately covered with yellow short hairs inter-

Fig. 2. Male of *Simulium* (*Nevermannia*) *ibarakiense* sp. nov. A, 3rd maxillary palpal segment with sensory vesicle (right side, front view); B, foreleg (left side, anterior view); C, midleg (left side, outer view), D, hind leg (left side, outer view); E, basitarsus and 2nd tarsal segment of hind leg (left side, outer view); F, coxite, styles, ventral plate and median sclerite *in situ* (ventral view); G and H, style (G, medial view; H, ventrolateral view); I, ventral plate and median sclerite (lateral view); J, ventral plate (end view); K, median sclerite (ventroposterior view); L, paramere (left side, end view); M, aedeagal membrane and dorsal plate (posterodorsal view); N and O, 10th abdominal segment and cercus (right side; N, lateral view; O, end view). Scale bars. 0.2 mm for B–D; 0.1 mm for E; 0.03 mm for A; 0.02 mm for F–O.



mixed with dark brown short to medium-long hairs on posterior segments; when viewed at certain angle of light, tergite 2 with pair of shiny dorsolateral spots, and tergites 5–8 each with pair of slightly shiny dorsolateral or lateral spots; ventral surface of segment 2 pale yellow, those of segments 3 and 4 light brown, and those of other segments medium brown; all sternites shiny when viewed at certain angle of light. ***Genitalia***. Coxite in ventral view (Fig. 2F) rectangular, 1.8 times as long as wide. Style in medial view (Fig. 2G) boot-shaped, with inwardly directed triangular flange with small spine at its apex; style in ventrolateral view (Fig. 2H) broad basally, slightly narrowed toward apical 2/5, then abruptly tapered toward apex, about 2.3 times as long as its basal width, and about 0.9 times as long as coxite. Ventral plate in ventral view (Fig. 2F) transverse, plate-like, slightly tapered posteriorly, about 2.0 times as wide as long, with anterior and posterior margins shallowly notched medially, and setose medially on posterior 2/5 of ventral surface; arms well sclerotized, slender, and with apical 1/2 strongly curved inwardly; ventral plate in lateral view (Fig. 2I) with posteroventral portion somewhat produced ventrally, and with arm slightly tapered toward apex, and slightly curved dorsally; ventral plate in end view (Fig. 2J) gently rounded ventrally, and setose medially on posterior surface and also on dorsal surface. Median sclerite in lateral view (Fig. 2I) arising just before anterior margin of ventral plate, and in ventroposterior view (Fig. 2K) narrow, nearly parallel-sided, and forked apically. Paramere in end view (Fig. 2L) narrow, with 1 long parameral hook directed laterally, and with small isolated sclerotized plate near base of hook. Aedeagal membrane (Fig. 2M) moderately covered with microsetae except ventral portion almost bare, and dorsal plate in posterodorsal view (Fig. 2M) moderately sclerotized, wide, with lateral margins deeply concave near base. Abdominal segment 10 in lateral view (Fig. 2N) with posterolateral corner partially dark-pigmented, with 3–6 hairs on each side. Cercus in lateral view (Fig. 2N) entirely dark-pigmented, rounded, and with 21–29 hairs; cercus in end view (Fig. 2O) narrow vertically.

Pupa. Body length (excluding gill filaments) 3.0–4.0 mm. ***Head***. Integument (Fig. 3A) yellowish-brown, moderately covered with round tubercles of nearly similar sizes; antennal sheath almost bare; frons usually with 3 simple trichomes (2 long and 1 medium-long or short, or 1 long and 2 medium-long, or all 3 long), or rarely with 2 simple trichomes (1 long and 1 medium-long) or with 1 long simple trichome on each side; face with 1 long simple (or rarely bifid) trichome on each side. ***Thorax***. Integument yellowish-brown, moderately or densely covered with round tubercles, and on each side with 3 long simple trichomes mediodorsally, 2 simple (or bifid in some pupae) trichomes (1 long and 1 medium-long) anterolaterally, 1 short or medium-long simple (or bifid in some pupae) trichome posterolaterally, and 3 simple trichomes (1 long, 2 short) ventrolaterally. Gill (Fig. 3B) with 4 slender thread-like filaments, longer than pupal body, arranged vertically in dorsal and ventral pairs arising from short basal common stalk; basal common stalk nearly as thick as interspiracular trunk, and with transparent swollen portion ventrally; stalk of ventral pair as thick as that of dorsal pair, but usually longer than that of dorsal pair which is variable in length, subequal in length to, or shorter or longer than, basal common stalk; all filaments nearly of same length (3.3–6.0 mm including basal stem; although 1 of 2 ventral paired filaments almost always slightly shorter than others) and thickness, dark gray to light brown, directed forwards, gradually tapered toward apex, furnished with annular ridges and furrows, and densely covered with minute tubercles on outer surface. ***Abdomen***. Dorsally, segments 1–3 weakly sclerotized and light brown, other segments pale yellow to yellow; segments 1–3 moderately covered with small tubercles, segment 4 sparsely or moderately covered with small tubercles anteriorly; segment 1 with 1 long slender simple seta on each side; segment 2 with 1 long slender simple seta and 5 short dark spinous setae on each side; segments 3 and 4, each with 4 dark stout hooks and 1 dark short spinous seta on each side; segments 5–8 each with spine-combs and comb-like groups of minute spines lying transversely along anterior margin on each side; segment 9 with pair of cone-shaped terminal hooks (Fig. 3C), and comb-like groups of minute spines (of which some developed, then appearing as spine-combs in some pupae) lying transversely along anterior margin on each side. Ventrally, segments 3–8 nearly transpar-

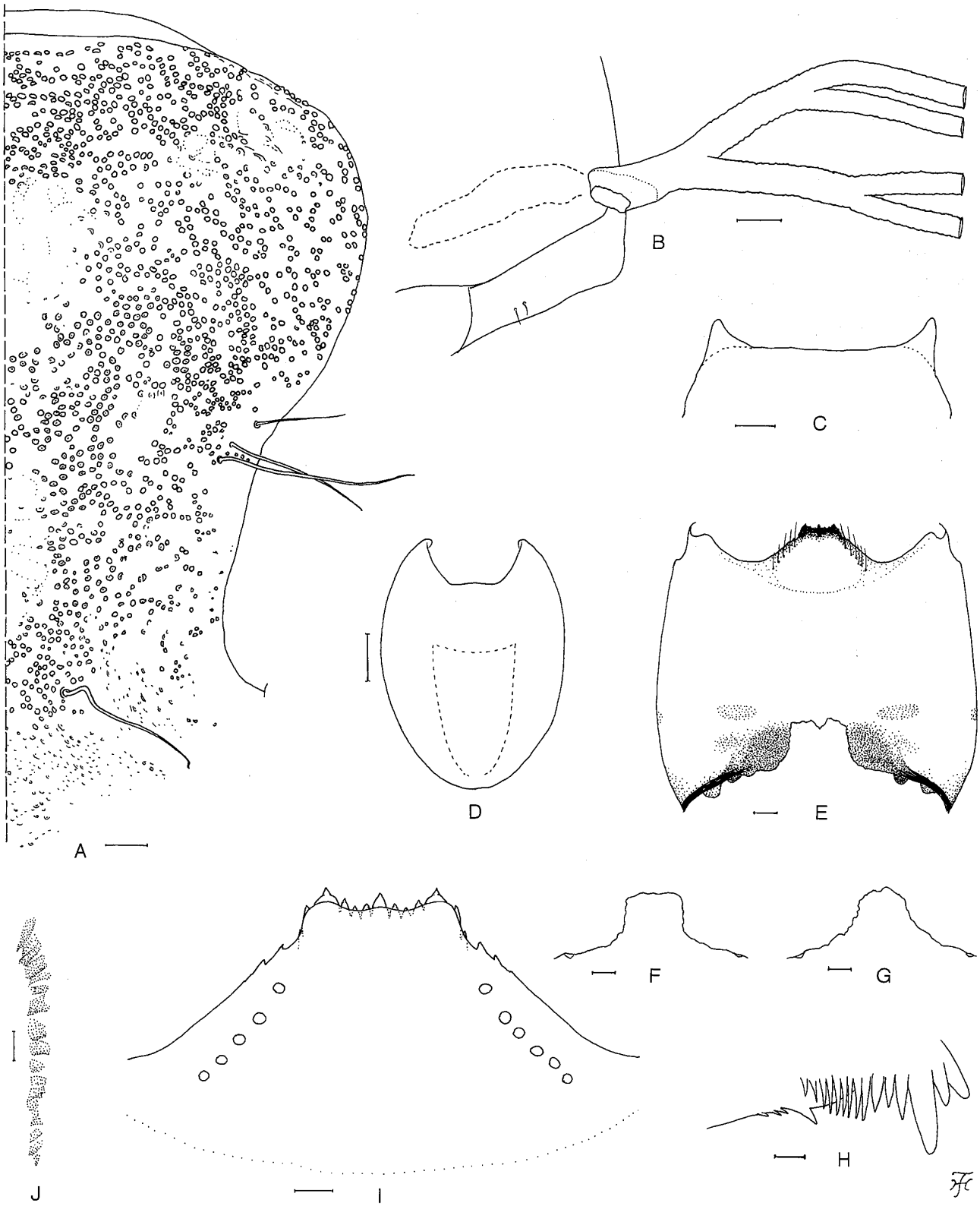


Fig. 3. Pupa and mature larva of *Simulium* (*Nevermannia*) *ibarakiense* sp. nov. A–D, pupa; E–J, larva. A, frons and part of face (left half); B, basal portion of gill filaments (right side, outer view); C, terminal hooks (end view); D, cocoon (dorsal view); E, head capsule (ventral view); F and G, postgenal cleft; H, mandible; I, hypostoma; J, accessory sclerite. Scale bars. 1.0 mm for D; 0.1 mm for B; 0.05 mm for E–G; 0.04 mm for A; 0.02 mm for C, I and J; 0.01 mm for H.

ent, segment 9 weakly sclerotized and yellow; segment 4 with 1 dark simple hooklet (slightly shorter and smaller than those on segments 5–7) and 3 short simple setae on each side; segment 5 with 2 dark bifid (or rarely trifid) hooks and a few short simple setae on each side; segments 6 and 7 each with 1 dark bifid inner hook and 1 dark simple outer hook, and a few short simple setae on each side; segments 4–8 with comb-like groups of minute spines. Segment 9 with 1 short simple seta on each lateral side. ***Cocoon*** (Fig. 3D). Simple, wall-pocket-shaped, neatly woven, thin except anterior margin thickly woven, and extending ventrolaterally; floor woven on posterior 3/5; individual threads visible or not; 4.5–5.8 mm long by 3.0–4.3 mm wide.

Mature larva. Body length 6.5–7.6 mm. Body color yellowish, without any color markings. Cephalic apotome whitish-yellow to yellow, usually with narrow portion along posterior margin slightly to moderately darkened; head spots distinctively positive though anterior one of mediolateral spots faint to varying degrees in most specimens. Lateral surface of head capsule mostly yellowish although area between eye-spot region and posterior margin darkened to varying degrees in some larvae; eyebrow well-defined, with 1 dark spot; 2 large and 1 or 2 small dark spots near posterior margin, and 1 small dark spot below eye-spot region distinctive, although 2 large spots merged into dark background color in some larvae. Ventral surface of head capsule (Fig. 3 E) usually yellow, with dark area on each side of postgenal cleft; dark elongate spot on each side of postgenal cleft distinctive. Cervical sclerites composed of 2 rod-like small pieces, not fused to occiput, widely separated from each other. Antenna composed of 3 segments and apical sensillum, much longer than stem of labral fan; proportional lengths of 1st, 2nd, and 3rd segments 1.0 : 1.06–1.09 : 0.48–0.85. Labral fan with 34–41 rays. Mandible (Fig. 3H) with 1st comb-tooth longest, followed by 3rd one which is longer than 2nd; mandibular serrations composed of 2 teeth (1 large and 1 small); large tooth at acute or right angle to mandible on apical side; a few supernumerary serrations present. Hypostoma (Fig. 3I) with row of 9 apical teeth, median tooth and corner teeth prominent; lateral margins smooth except near apex serrated; hypostomal bristles 5–7 in row, parallel to or slightly diverging from lateral margin on each side. Postgenal cleft (Fig. 3E–G) small, 0.39–0.43 times as long as postgenal bridge, M-shaped or quadrate or rounded anteriorly. Thoracic and abdominal cuticle almost bare except dorsal surface of a few posterior abdominal segments sparsely to moderately covered with colorless minute setae and small areas on both sides of anal sclerite moderately covered with colorless short setae. Rectal scales darkened, well discernible. Rectal papilla simple. Anal sclerite X-shaped, anterior arms subequal in length to posterior ones; accessory sclerites absent in most larvae but present as vertical streak of a few to several dark pieces (Fig. 3J) just in front of posterior circlet on each side in 5 of 80 mature larvae examined; sensillum absent. Ventral papillae well developed, conical. Posterior circlet of hooks with 88–100 rows of up to 15 or 16 hooks per row.

TYPE SPECIMENS. Holotype female (reared from pupa) with its associated pupal exuviae and cocoon (preserved in 80% ethanol), collected from a slow-flowing stream (width about 30 cm, water temperature 12℃, partially shaded, altitude 160 m) in a mountain base, Uchihata, Kitaibaraki City, Ibaraki Prefecture, Honshu, Japan, 24. IV. 2007, by K. Saito. Paratypes: 13 females, 10 males (all reared from pupae), 5 pupae and 80 mature larvae, same data as those of the holotype.

ECOLOGICAL NOTES. The pupae and larvae of this new species were collected from leaves of sweet flags (*Acorus calamus*) trailing in water, together with those of *S.* (*N.*) *uchidai* (Takahasi), *S.* (*Simulium*) *oitanum* (Shiraki), *S.* (*S.*) *japonicum* Matsumura and *S.* (*S.*) *rufibasis* Brunetti.

REMARKS. *Simulium* (*N.*) *ibarakiense* sp. nov. is assigned to the *vernum* species-group within the subgenus *Nevermannia* by having the male ventral plate lamellate, without a median keel (Fig. 2F), style elongate, with a large, broad, inwardly-twisted apex (Fig. 2F, G), paramere with a single hook (Fig. 2L), and median sclerite inverted-Y-shaped (Fig. 2K), pupal gill

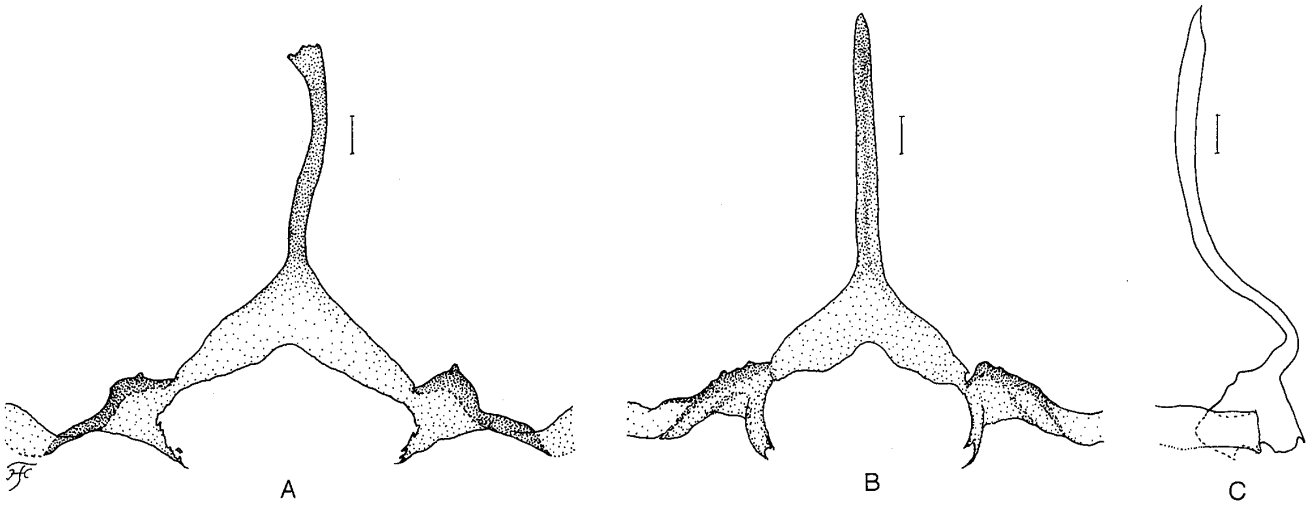


Fig. 4. Aberrant genital forks of two females of *Simulium* (*Nevermannia*) *ibarakiense* sp. nov. infected with a mermithid nematode. A, genital fork with 1 small projection directed anteriorly on each arm; B, genital fork with 1 or 2 small projections directed anteriorly on each arm; C, lateral view of the same genital fork (B). Scale bars. 0.02 mm for A–C.

with four slender filaments (Fig. 3B), and larval mandible with supernumerary serrations (Fig. 3H).

This new species is very similar to *S.* (*N.*) *uemotoi* Sato, Takaoka and Fukuda, described from Japan (Sato et al., 2004), in many morphological characteristics including the haired katepisternum of both sexes of adults, which occurs very rarely in this species-group. However, there is a clear difference in the leg color of both female and male adults between the two species: for example, the female mid trochanters (Fig. 1E, F) and the male fore coxae (Fig. 2B) are darkened in *S.* (*N.*) *ibarakiense* sp. nov. while those are not in *S.* (*N.*) *uemotoi*. Moreover, the male of this new species is distinguished from that of *S.* (*N.*) *uemotoi* by the larger number of the upper eye facets in 18–20 vertical columns and 20 or 21 horizontal rows (cf., in 14 or 15 vertical columns and 16 or 17 horizontal rows in the latter species; in the original description for *S.* (*N.*) *uemotoi*, the number of vertical columns was erroneously replaced with that of horizontal rows, and vice versa). In the larval stage, this new species differs from *S.* (*N.*) *uemotoi* in that its abdomen lacks a pair of small light brown submedian spots dorsally on segments 3–5 (or 6), which are at least faintly discernible in all the five larvae of *S.* (*N.*) *uemotoi* recently collected at Kuju, Oita (type locality of the latter known species).

The small M-shaped larval postgenal cleft (Fig. 3E), together with darkened legs of adults (Figs. 1D–G and 2B–D), seems to relate this new species to *S.* (*N.*) *karzhantavicum* (Rubtsov) reported from Turkmenia (Rubtsov, 1956) but the female of the latter species is easily distinguished by the genital fork with a distinct projection directed anteriorly on each arm. It is noteworthy that two females of *S.* (*N.*) *ibarakiense* sp. nov. infected with a mermithid nematode in their abdomen had the genital fork with one or two small projections directed anteriorly on each arm (Fig. 4A–C). However these genital forks are apparently aberrant in having the shortened stem, and projections on their arms are much smaller than those of *S.* (*N.*) *karzhantavicum* (Rubtsov, 1956).

This new species is distinctive in that some (6.25%) larvae have accessory sclerites (Fig. 3J), which have not been reported in any other species of the *vernum* species-group in Japan.

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